



REGRESSION ANALYSIS OF COST AND ECONOMIC RETURNS OF MAJOR CROPS IN SELECTED STATES OF INDIA FROM 2000-01 TO 2021-22

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ABSTRACT

Indian agriculture had reached the stage of development and maturity much before the now advanced countries of the world embarked on the path of progress. The share of agriculture in national income is often taken as an indicator of economic development. This study analysed and compared the cost and returns of principal crops in five major producing states of India like, Andhra Pradesh, Gujarat, Karnataka, Maharashtra and TamilNadu from 2000-01 to 2021-22. Data on the important variables like, cost of cultivation, production and yield of major crops like Paddy, Wheat, Maize and cotton. The study based on secondary information comprises from Agricultural statistics and Directorate of Economics and Statistics. For analysis of econometric technique like Simple linear regression model and Semi-log linear model were used in this study. The major objectives of the study are, to estimate the regression for cost of cultivation, production and yield of principal crops in selected states in India from 2000-01 to 2021-22 and to study the yield rates of principal crops in selected states of India during the study period. The major findings were derived the study are, the yield per hectare of all food grains has increased by more than two times in 2001 to 2017. The net return of paddy was Rs. 10, 870 per hectare and the return of Wheat was Rs. 8614. 32 per hectare in 2017. The study of cost and return is a major economic analysis because the estimation of product cost is useful to decision making process at crop level and the profitability of the farmers, it can help in planning of future production.

KEYWORDS: Cost of Production, Cost of Cultivation, Yield of Principle Crops, Simple Linear Regression Model, Semi-Log Model

INTRODUCTION

Indian Agriculture was backward and qualitatively traditional in nature and productivity per hectare and per worker was extremely low on the eve of the first five year plan. Though its contribution to the overall GDP of the country has declined from 55.3 percent in 1950-51 to 14 percent in 2021-22. An average Indian still spends almost half of their total expenditure on food and half of India's work force is still engaged in agriculture for its livelihood. Indian agriculture had reached the stage of development and maturity much before the now advanced countries of the world embarked on the path of progress. The share of agriculture in national income is often taken as an indicator of economic development. This study analysed and compared the cost and returns of principal crops in five major producing states of India like, Andhra Pradesh, Gujarat, Karnataka, Maharashtra and TamilNadu from 2000-01 to 2021-22.

Objectives of the study

The major objectives of the study are,

1. To estimate the regression for cost of cultivation, production and yield of principal crops in selected states in India from 2000-01 to 2021-22.
2. To evaluate the growth of rate of principal crops in selected

states of India from 2000-01 to 2021-22.

METHODOLOGY OF THE STUDY

The study based on secondary information compiled from various published sources. The information were collected from Directorate of Economic and Statistics, Ministry of Agriculture, Agricultural Statistics. Data were collected for five crops in major producing states of India from 2000-01 to 2021-22. Data on the important variables like, cost of cultivation, cost of production and yield of major crops of Paddy, Wheat, Maize, Cotton and Sugarcane.

To estimate the trend of cost of cultivation, cost of production and yield of principal crops were using the econometric technique like Simple linear regression model. Compound annual growth rates have been calculated by using Semi-log linear model.

The simple linear equation of the Model is,

$$Y_i = \alpha + \beta X_i + U_i, \text{ Where,}$$

α = intercept,

β = regression coefficient (slope)

Y = Time series data of cost of cultivation, cost of Production and yield of principles crops in India.

X_i = the time periods (2000-01 to 2021-22, where $i = 1, 2, 3, \dots, n$) and

$$\beta = \frac{\sum x_i y_i}{\sum x_i^2}$$

If β is positive, then y is increasing over time and if β is negative, y is decreasing over time. If β has statistically significant at 5 per cent level and at $(n-2)$ degrees of freedom and R^2 value is fairly high indicates that the change in y every year is a constant and is equal to β .

To estimate the compound growth rate using the semi-log functions of the form

$Y = \alpha \beta^t e^u$ have been estimated.

The Compound Growth Rate (CGR) is calculated by using exponential form of the equation

$CGR = \{(\text{anti log of } \beta) - 1\} \times 100$.

The growth rates were tested from the significance of "t" test.

$$t_{(\text{calculated Value})} = \frac{\beta}{SE(\beta)}$$

Where, β = regression coefficient,

$SE(\beta)$ = standard error of regression coefficient.

Concepts used in the study

Cost: Cost refers to the total amount of fund that is used for the purpose of production or productive purpose.

Cost of Cultivation: Cost of Cultivation is the total cost incurred in cultivating per unit area of land and expressed in Rs/ha.

Cost of Production: Cost of Production is the total cost incurred in production of per unit of crops output and expressed in Rs/ql.

Regression Analysis of Cost and Economic Returns of Major Crops in Selected States of India

The Central Sector Scheme for Studying the Cost of Cultivation of Principal Crops in India started in the year 1970-71. At present 19 States (Andhra Pradesh, Assam, Bihar, Chhatisgarh, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal) are covered under the scheme. The scheme envisages collection of representative data on inputs and outputs in physical and monetary terms, compilation and supplying the estimates of cost of cultivation per hectare and cost of production per quintal of the selected crops to CACP every year on a continuing basis. The major findings were derived the study are, the yield per hectare of all food grains has increased by more than two times in 2001 to 2017. The net return of paddy was Rs.10, 870 per hectare and the return of Wheat was Rs. 8614. 32 per hectare in

2017. The study of cost and return is a major economic analysis because the estimation of product cost is useful to decision making process at crop level and the profitability of the farmers, it can help in planning of future production.

Paddy		α	β	Standard Error of β	t-Statistics of β	Sig-t/p-value	R^2
Cost of Cultivation ('/Hect-are)	Andhra Pradesh	28243.9	2483.15	716.49	3.47	0.074	0.86
	Orissa	13444.4	3201.45	588.27	5.44	0.032	0.94
	Punjab	24046.3	2004.34	544.01	3.68	0.066	0.87
	Uttar Pradesh	13616.58	3332.10	894.56	3.72	0.065	0.87
	West Bengal	19802.10	4445.70**	281.98	15.77	0.003	0.99
Cost of Production ('/Quintal)	Andhra Pradesh	767.97	54.39	21.09	2.57	0.123	0.77
	Orissa	501.145	168.11	29.64	5.67	0.029	0.94
	Punjab	604.3	76.66**	6.44	11.91	0.004	0.98
	Uttar Pradesh	660.19	66.95	20.52	3.26	0.082	0.84
	West Bengal	620.93	122.12	14.00	8.72	0.012	0.97
Yield (Quintal/Hect-are)	Andhra Pradesh	57.83	-1.72	0.22	-7.54	0.083	0.98
	Orissa	34.94	-2.06	0.727	-2.832	0.216	0.89
	Punjab	71.12	-3.46	0.433	-7.990	0.079	0.98
	Uttar Pradesh	36.33	0.45	0.302	1.498	0.374	0.69
	West Bengal	40.456	-1.095	0.557	-1.965	0.299	0.79

Source: Computed values from Directorate of Economics and Statistics, Ministry of Agriculture. Cost includes all actual expenses in cash & kind incurred in production by owner and rent paid for leased in land. Family Labour, is imputed on the basis of statutory wage rate or the actual market rate, whichever is higher.** indicates that statistically significant at 5 per cent level.

Table 1: Estimated regression result of cost of cultivation, production and yield of paddy in selected states of India from 2000-01 to 2021-22

The estimated regression analysis explained that the cost of production, cultivation and yield of paddy in selected states of India from 2000-01 to 2021-22. Most of the slope co-efficient was statistically significant at 5 per cent level. The cost of cultivation of paddy in Andhra Pradesh, on an average of Rs. 2483.15 increases per hectare on a year. But in Punjab, the cost was decreases to Rs. 2004.34. The cost of cultivation was low comparatively other states like Uttar Pradesh, West Bengal and Orissa. Production cost of paddy in per quintal was 54.39 and in West Bengal was 122.12 quintal over the period after introducing the economic reforms in India. Yield per hectare, there was a negative trend in over the period of states like Andhra Pradesh, Orissa, Punjab and West Bengal. There was a positive trend in Uttar Pradesh. The co-efficient of determination (R^2) of Production, Cultivation and Yield of paddy explained that more than 80 percentage of the variation in the dependent variable that can be explained by the independent variable. Punjab

farmers were the most efficient paddy producers, reducing the cost of production relative to the all-India average during the study period. They produced a quintal (about 100 kilograms) of paddy at 15 percent lower than the all-India average. On the other hand, Haryana farmers incurred the highest cost in paddy production, which was 28 percent higher than the others.

Wheat		α	β	Standard Error of β	t-Statistics of β	Sig-t/p-value	R ²
Cost of Cultivation ('/Hectare)	Haryana	17382.13	2360.67	577.82	4.085	0.055	0.89
	Madhya Pradesh	10206.4	1836.93	244.718	7.506	0.017	0.97
	Punjab	15201.53	2613.68**	79.262	32.974	0.000	0.99
	Rajasthan	15797.23	2272.32	1198.134	1.8965	0.198	0.64
	Uttar Pradesh	16366.88	2259.637	345.72	6.535	0.022	0.96
Cost of Production ('/Quintal)	Haryana	707.445	34.29	22.898	1.497	0.272	0.53
	Madhya Pradesh	788.51	15.08	3.976	3.792	0.063	0.88
	Punjab	768.97	30.61	5.761	5.312	0.033	0.93
	Rajasthan	625.19	38.479	28.423	28.423	0.308	0.48
	Uttar Pradesh	721.045	45.285	20.260	2.235	0.154	0.71
Yield (Quintal/Hectare)	Haryana	44.25	-0.13	2.667	-0.0487	0.968	0.23
	Madhya Pradesh	21.18	2.29	0.207	11.017	0.057	0.99
	Punjab	38.25	1.52	0.098	15.486	0.041	0.99
	Rajasthan	34.836	1.185	2.0236	0.585	0.662	0.26
	Uttar Pradesh	33.34	0.91	1.281	0.709	0.606	0.34

Source: Computed values from Directorate of Economics and Statistics, Ministry of Agriculture. Cost includes all actual expenses in cash & kind incurred in production by owner and rent paid for leased in land. Family Labour, is imputed on the basis of statutory wage rate or the actual market rate, whichever is higher. ** indicates that statistically significant at 5 per cent level.

Table 2: Estimated regression of cost of cultivation, production and yield of Wheat in selected states of India from 2000-01 to 2021-22

Table 2 depicts that, most of the estimated slope coefficients were statistically insignificant at 5 percent level. The cost of cultivation of wheat in Punjab was statistically significant. The value of the slope coefficient was 2613.68. This had disclosed that on an average cost of cultivation of wheat had been increased to Rs.2613.68 per hectare a year over the study period. Other states like Uttar Pradesh, Haryana, Rajasthan and Madhya Pradesh on an average of cost of cultivation was Rs. 2259.64, Rs.2360.67, Rs. 2272.32 and Rs. 1836.93 per hectare respectively. The cost of production of wheat was low in Madhya Pradesh and high in Madhya Pradesh. At the same time, yield per hectare of wheat was low in Haryana and high in Punjab. In Uttar Pradesh, the average yield was 0.91 per hectare over the period of time. The explanatory variable like time(x)

could explained more than 60 percentage of the variation in the dependent variables like Cost of cultivation, Production and Yield of Wheat in selected states of India from 2000-01 to 2021-22. The states of Rajasthan, Bihar, and Haryana were observed to be efficient wheat producers

Cotton		α	β	Standard Error of β	t-Statistics of β	Sig-t/p-value	R ²
Cost of Cultivation ('/Hectare)	Andhra Pradesh	23356.6	3055.26	1902.006	1.606	0.249	0.56
	Gujarat	23661.43	4054.981	1124.53	3.605	0.069	0.87
	Haryana	26464.91	2410.33	1663.26	1.44	0.284	0.52
	Maharashtra	14043.53	7804.76	1226.724	6.362279	0.023	0.96
	Punjab	23384.71	3812.36	1585.77	2.404	0.138	0.74
Cost of Production ('/Quintal)	Andhra Pradesh	1934.515	404.146	129.468	3.121	0.089	0.83
	Gujarat	1658.225	345.409	132.731	2.602	0.121	0.77
	Haryana	1719.415	369.332	22.937	16.101	0.003	0.99
	Maharashtra	1882.775	526.828	103.236	5.103	0.03632	0.93
	Punjab	1301.04	586.036	73.049	8.022	0.015	0.97
Yield (Quintal/Hectare)	Andhra Pradesh	19.7566	-1.445	0.834	-1.732	0.333	0.75
	Gujarat	16.973	1.48	1.033	1.432	0.388	0.67
	Haryana	22.243	-1.82	0.906	-2.007	0.294	0.80
	Maharashtra	11.716	0.855	0.204	4.171	0.149	0.95
	Punjab	28.77	-4.045	0.591	-6.835	0.092	0.98

Source: Computed values from Directorate of Economics and Statistics, Ministry of Agriculture. Cost includes all actual expenses in cash & kind incurred in production by owner and rent paid for leased in land. Family Labour, is imputed on the basis of statutory wage rate or the actual market rate, whichever is higher. ** indicates that statistically significant at 5 per cent level.

Table 3: Estimated regression of cost of cultivation, production and yield of Cotton in selected states of India from 2000-01 to 2021-22

Table 3 depicts that the cost of cultivation, production and yield of cotton in selected states of India from 2000-01 to 2021-22. Most of the slope coefficient was statistically insignificant at 5 percent level. Cost of cultivation of cotton was high in Madhya Pradesh and Gujarat (Rs. 7804.76 and Rs. 4054.98) per hectare in over the period of study. Other states like Punjab, Andhra Pradesh and Haryana cost of cultivation was less. At the same, the Production cost was less in Gujarat and Haryana and high in Punjab and Maharashtra. Yield in cotton was very low in Punjab, Haryana and Andhra Pradesh. The other states like Gujarat and Maharashtra was least per quintal.

Compound Growth Rate	Paddy	Wheat	Cotton
Cost of Cultivation (₹/Hectare)	0.27	1.29	1.33
Cost of Production (₹/Quintal)	2.31	2.75	1.79
Yield (Quintal/Hectare)	-0.73	0.32	-0.17

Source: Computed values from Directorate of Economics and Statistics, Ministry of Agriculture.

Table 4: Compound Growth rates of Cost of Cultivation, Production and Yield of selected crops in India from 2000-01 to 2021-22 (Area (000 ha), Production (000 Tonnes), Yield (kg/ha)

The above table shows that compound growth rate of cost of cultivation, production and yield of Paddy, Wheat and cotton of selected states of India from 2000-01 to 2021-22. Cost of cultivation of paddy, wheat and cotton was Rs.0.27, Rs.1.29 and Rs.1.33 per hectare in a year. Cost of production was high in compared to cost of cultivation of these three crops. But in yield per hectare was less in Paddy and Cotton.

Paddy				
World	163000	741000	4546	100.00
China	30300	207000	6832	27.94
India	43900	157000	3576	21.19
Indonesia	13800	70800	5130	9.55
Bangladesh	11300	52300	4628	7.06
Vietnam	7816	45000	5757	6.07
Wheat				
World	220000	729000	3314	100.00
China	24100	157000	6515	21.54
India	30500	95900	3144	13.16
USA	18800	55100	2931	7.56
Canada	9462	29300	3097	4.02
Australia	12600	25300	2008	3.47

Source: Directorate of Economics and Statistics, Ministry of Agriculture.

Table 5: Global Comparison of Area, Production and Yield of Principal Crops in 2014 (Area (000 ha), Production (000 Tonnes), Yield (kg/ha)

Global level comparison of Paddy and Wheat of primary food crops in all over the world in 2014. In China (27.94 % and 21.54 %) and India (21.19 % and 13.16 %) were producing more in Paddy and wheat. Globally this two countries were producing more in food crops.

CONCLUSION

Agricultural price policy has been largely successful in playing a major role in providing reasonable margin levels over production costs to farmers of both wheat and paddy. Nonetheless, the margin over total cost and variable cost had

declined in the post-reform period in both crops. The net income in real terms had declined also, leading to distress among farmers. The decline in profitability has discouraged farmers from increasing their spending on yield-augmenting technology, resulting in poor yield growth rates and in a decline in production growth rates. The deceleration in growth of agricultural productivity during the post-reform period had put pressure on the production of wheat and paddy; it also forced the government to take measures to reverse such trends. Since then, conscious efforts have been made to raise investments in agriculture. The slowdown in agriculture growth could be attributed to the supply side factors such as public investment, irrigation water management, rural credit, technology, land management, agricultural research and development including extension services, rural infrastructure like roads, electricity, marketing, post-harvest management and so on. Reforms are needed to address these issues in order to achieve 4 to 4.5 percent growth in agriculture.

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